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Systematic review of absorbable *vs* non-absorbable sutures used for the closure of surgical incisions

Muhammad S Sajid, Malcolm R McFall, Pauline A Whitehouse, Parv S Sains

Muhammad S Sajid, Western Sussex Hospitals NHS Trust, Washington Suite, North Wing, Worthing Hospital, BN11 2DH West Sussex, United Kingdom
Muhammad S Sajid, Malcolm R McFall, Pauline A Whitehouse, Parv S Sains, Department of General, Endoscopic and Laparoscopic Colorectal Surgery, Worthing Hospital, Worthing, BN11 2DH West Sussex, United Kingdom
Author contributions: All authors contributed to this paper.
Correspondence to: Mr. Muhammad S Sajid, Western Sussex Hospitals NHS Trust, Washington Suite, North Wing, Worthing Hospital, BN11 2DH West Sussex, United Kingdom. surgeon1wrh@hotmail.com
Telephone: +44-01903-205111 Fax: +44-01903-285010
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Abstract

AIM: To report a systematic review of published randomized controlled trials (RCTs) investigating the role of absorbable suture (AS) against non-AS (NAS) used for the closure of surgical incisions.

METHODS: RCTs investigating the use of AS *vs* NAS for the closure of surgical incisions were statistically analysed based upon the principles of meta-analysis and the summated outcomes were represented as OR.

RESULTS: The systematic search of medical literature yielded 10 RCTs on 1354 patients. Prevalence of wound infection (OR = 0.97; 95%CI: 0.56, 1.69; Z = 0.11; P = 0.92) and operative morbidity (P = 0.45) was comparable in both groups. Nonetheless, the use of AS lead to lower risk of wound break-down (OR = 0.12; 95%CI: 0.04, 0.39; Z = 3.52; P < 0.0004).

CONCLUSION: This meta-analysis of 10 RCTs demonstrates that the use of AS is similar to NAS for skin closure for surgical site infection and other operative morbidities. AS do not increase the risk of skin wound dehiscence, rather lead to a reduced risk of wound dehiscence compared to NAS.

Key words: Skin closure; Surgical site infection; Wound dehiscence; Absorbable sutures; Non-absorbable suture

Core tip: Based upon the meta-analysis of 10 controlled trials, the absorbable sutures (AS) are similar to non-AS (NAS) for skin closure in cases of wound infection and other complications. AS do not increase the risk of skin wound dehiscence, rather leads to a reduced risk of wound break-down compared to NAS.

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INTRODUCTION

A number of studies have been reported in search of improving the skin closure related outcome measures following various surgical procedures, and due to this fact the skin closure techniques are evolving vastly and immensely, predominantly over the last few decades. Innumerable skin closure methods reported in medical literature include continuous stitch closure, interrupted stitch closure, full thickness closure, sub-cuticular closure, primary closure, secondary closure, vacuum assisted closure, glue assisted closure, skin clips or staples closure, simple suture *vs* mattress sutures, steri-strips closure, absorbable or non-absorbable suture (NAS) closure and other innovative methods[1-13]. These manifold practices of skin approximation after surgical procedures can

jointly be classified into two groups. Group I includes the use of NAS for skin closure requiring additional clinical care due to the need of removal of stitches or metallic staples. Group Ⅱ includes the use of absorbable stitches (AS) or glue which does not require additional clinical care like the group I . The proponents of the use of NAS for skin closure claim that an increased tensile strength of NAS keep wound margins adequately coapted resulting in optimal wound and skin healing[14-16]. The supporters of AS advocate similar effectiveness in wound healing without the requirement of additional clinical care in addition to the benefits of an improved cosmetic outcome and the reduced risk of surgical site infection[17-21]. Due to significant differences in the opinion, the general consensus about the use of either absorbable AS or NAS is still lacking.

The aim of this study is to report a systematic review of published randomized controlled trials (RCTs) on the use of AS against NAS for skin closure.

MATERIALS AND METHODS

Literature search pattern

Relevant published trials for this study were retrieved from the search of MEDLINE, EMBASE, and Cochrane library for controlled trials (RCTs). The MeSH search words such as "absorbable sutures" and "non-absorbable sutures" were put in medical search engines to find studies suitable for inclusion in this systematic review. There was no linguistic, sex, trial size or country of study barrier in our search or inclusion criteria. Boolean operators (AND, OR, NOT) were entered repeatedly at different levels of literature search to achieve maximum number of studies. The published designations of the relevant articles were analysed and checked about their possibility of inclusion in this study. Furthermore, the bibliography of the potentially included studies was scrutinized to find additional studies.

Study selection

The inclusion criteria for this study was agreed which included the RCTs comparing AS and NAS, using any type of AS and NAS, investigating surgical site infection as primary end point without any limitations of age, sex on recruited patients.

Data extraction

After trial selection according to the principles of inclusion criteria, two review authors extracted the trial data from included studies. In case conflict about data, the mutual agreement was achieved by lengthy discussions among all authors. We did not use any statistical tool to calculate the inter-observer matching pattern of the data.

Statistics of the study

The statistics calculations were performed on RevMan 5.3[22,23], delivered by the Cochrane Collaboration. The OR with a 95%CI was calculated to express the

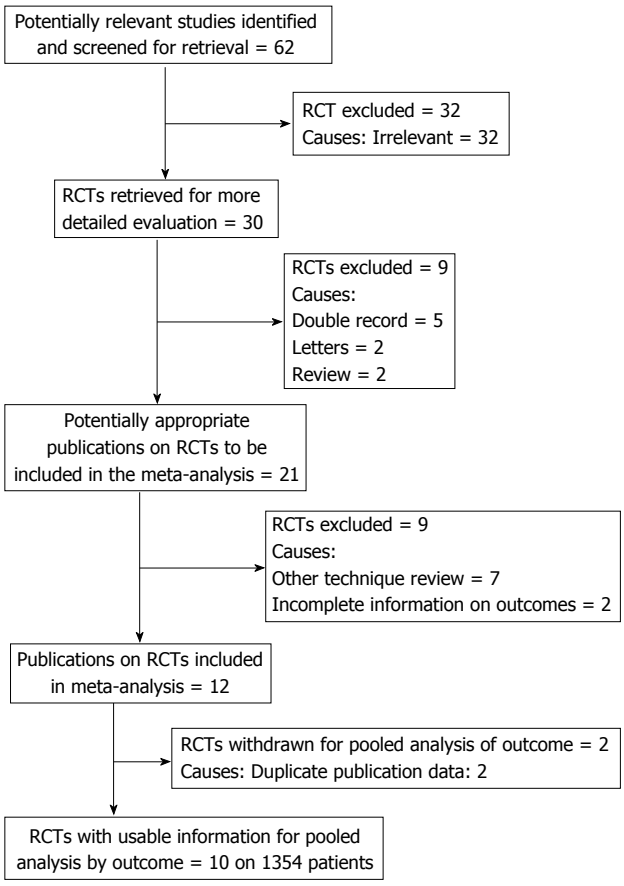

Figure 1 PRISMA flow chart showing trial selection methodology. RCT: Randomized controlled trial.

combined outcome of the dichotomous variables. The random or fixed effects model using Mantel-Haenszel method (where applicable)[24,25] were used to compute the combined results. The χ^2 test and the I^2 were used for detection and quantification of heterogeneity[26-28]. The results were displayed in the form of forest plot. The quality of included RCTs was scrutinised according to the reported recommendations by Jadad *et al*[29] and Chalmers *et al*[30]. Based on the quality of the included RCTs, the strength and summary of GRADE quality of evidence was achieved using GradePro®[28], an analytical package offered by the Cochrane Collaboration. The surgical site infection was analysed as primary outcome whereas post-operative complications and wound dehiscence was reported as secondary outcomes.

RESULTS

The PRISMA diagram flow chart explaining the trial selection approach, filtration of trials and eventual study inclusion for quantitative and qualitative analysis is shown in Figure 1. Ten RCTs[31-41] on 1354 patients were found suitable for inclusion and for final analysis. Six hundred and sixty-three were investigated in the AS arm and 691 in NAS arm of the included RCTs. Table 1 depicts the characteristics of the included RCTs. Table 2 is showing the various procedures, type of sutures, type of stiches

Table 1 Characteristics of included trials

Ref.	Year	Country	Age in years	Male:female	Duration of follow up	Operative procedure
Dørflinger *et al*[32]						
AS	1983	Denmark	64 (11-83)	27:2	6 mo	Inguinal and femoral hernia repair
NAS			64 (19-85)	21:8		
Foster *et al*[33]						
AS	1977	United Kingdom	NA	NA	1 mo	Appendicectomy
NAS						
Glough *et al*[34]						Laparotomy
AS	1975	United Kingdom	NA	Mixed groups of males and females	4 wk	Inguinal and femoral hernia repair
NAS						
Harimoto *et al*[35]						
AS	2011	Japan	68 ± 10	37:25	30 d	Hepatectomy
NAS			67 ± 12	41:22		
Kotaluoto *et al*[36]						
AS	2012	Finland	40.6 (18-88)	45:45	3 wk	Appendicectomy
NAS			40.5 (18-83)	63:32		
Lundblad *et al*[37]						
AS	1989	Norway	NA	NA	NA	Appendicectomy
NAS						Inguinal hernia repair
Pauniaho *et al*[38]						
AS	2010	Finland	12.7 (4-17)	57:43	1 wk	Appendicectomy
NAS			12.7 (4-18)	54:44		
Ralphs *et al*[39]						
AS	1982	United Kingdom	NA	NA	18 mo	Inguinal hernia repair
NAS						
Szabó *et al*[40]						
AS	2002	Hungary	64.7 (23-87)	23:2	3 mo	Inguinal hernia repair
NAS			66.3 (25-86)	21:4		
Tan *et al*[41]						
AS	2008	Malaysia	30.8 ± 7.9	0:106	4 wk	Transverse suprapubic for benign gynaecological surgery or c-section
NAS			31.6 ± 6.9	0:107		

AS: Absorbable suture; NAS: Non-absorbable suture; NA: Not available.

Table 2 Treatment protocol adopted in included trials

Ref.	Absorbable suture	Non-absorbable suture
Dørflinger *et al*[32]	Polyglycolic acid	Dacron just for aponeurotic layer
Foster *et al*[33]	Subcuticular Polyglycolic acid	Interrupted 00 nylon 1 cm apart
Glough *et al*[34]	Polyglycolic acid 3/0 straight needle	Silk 2/0 straight needle
Harimoto *et al*[35]	Polyglactin	Silk
Kotaluoto *et al*[36]	4/0 monofilament monocryl	4/0 interrupted Ethilon
Lundblad *et al*[37]	3/0 polyglycolic	4/0 monofilament nylon
Pauniaho *et al*[38]	4/0 polyglactin 910/370	4/0 braided nylon
Ralphs *et al*[39]	3/0 Dexon	5/0 nylon
Szabó *et al*[40]	Polyglactin 910/370	Monofilament nylon
Tan *et al*[41]	Monofilament poliglecaprone 25	Monofilament polypropylene

used in included RCTs.

Methodological quality of included studies

Inadequate randomization approach, improper concealment in the process of allocation, absence of power calculations, lack of utilization of single or double blinding and lastly lack of reporting of IIT were major factors responsible for scoring the majority of included RTCs of poor quality (Table 3). GRADE[31] quality of evidence is shown in Figure 2.

Surgical site infection

There was no heterogeneity [Tau^2 = 0.23, χ^2 = 12.12, γ = 8, (P = 0.15); I^2 = 34%] among RCTs that contributed to the combined calculation of this variable. In the random effects model (OR = 0.97; 95%CI: 0.56, 1.69; Z = 0.11; P = 0.92; Figure 3), the risk of surgical site infection was statistically similar in both groups. Although the AS lead to lower incidence of wound infection but it failed to reach at statistical significance.

Postoperative complications

Combined analysis showed significant statistical heterogeneity [Tau^2 = 0.61, χ^2 = 20.57, γ = 9, (P = 0.01); I^2 = 56%] among included RCTs. Therefore, in the random effects model (OR = 0.77; 95%CI: 0.39, 1.52;

Table 3 Quality assessment of included trials

Ref.	Randomisation technique	Power calculations	Blinding	Intention-to-treat analysis	Concealment
Dørflinger *et al*[32]	Consecutive patients	No	Yes	No	Inadequate
Foster *et al*[33]	Consecutive patients	No	No	No	Inadequate
Glough *et al*[34]	Consecutive patients	No	No	No	Inadequate
Harimoto *et al*[35]	Sealed envelop	Yes	No	No	Adequate
Kotaluoto *et al*[36]	Consecutive patients	Yes	No	Yes	Inadequate
Lundblad *et al*[37]	Consecutive patients	No	No	No	Inadequate
Pauniaho *et al*[38]	Consecutive patients	Yes	No	No	Inadequate
Ralphs *et al*[39]	Consecutive patients	No	No	No	Inadequate
Szabó *et al*[40]	No	No	No	No	Inadequate
Tan *et al*[41]	Consecutive patients	Yes	No	Yes	Inadequate

Absorbable compared to non-absorbable sutures for for skin closure

Patient or population: for skin closure
Settings:
Intervention: Absorbable
Comparison: non-absorbable sutures

Outcomes	Illustrative comparative risks* (95% CI) Assumed risk non-absorbable sutures	Corresponding risk Absorbable	Relative effect (95% CI)	No of Participants (studies)	Quality of the evidence (GRADE)	Comments
Surgical site infection Odds ratio Follow-up: 1-78 weeks	Study population		OR 0.97 (0.56 to 1.69)	1354 (10 studies)	⊕⊕⊕⊖ moderate	
	77 per 1000	75 per 1000 (44 to 123)				
	Moderate					
	63 per 1000	61 per 1000 (36 to 102)				
Postoperative complications Odds ratio Follow-up: 1-78 weeks	Study population		OR 0.77 (0.39 to 1.52)	1354 (10 studies)	⊕⊕⊕⊖ moderate	
	97 per 1000	76 per 1000 (40 to 140)				
	Moderate					
	72 per 1000	56 per 1000 (29 to 105)				
Risk of wound dehiscence Odds ratio Follow-up: 1-78 weeks	Study population		OR 0.12 (0.04 to 0.39)	737 (6 studies)	⊕⊕⊕⊖ moderate	
	63 per 1000	8 per 1000 (3 to 26)				
	Moderate					
	35 per 1000	4 per 1000 (1 to 14)				

*The basis for the **assumed risk** (e.g. the median control group risk across studies) is provided in footnotes. The **corresponding risk** (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: Confidence interval; **OR:** Odds ratio;

GRADE Working Group grades of evidence
High quality: Further research is very unlikely to change our confidence in the estimate of effect.
Moderate quality: Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.
Low quality: Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.
Very low quality: We are very uncertain about the estimate.

Figure 2 Strength and summary of the evidence analysed on GradePro®.

Study or subgroup	Absorbable suture Events	Total	Non-absorbable suture Events	Total	Weight	Odds ratio M-H, random, 95%CI
Dorflinger 1983	0	29	0	29		Not estimable
Foster 1977	21	62	9	65	18.5%	3.19 (1.32, 7.67)
Glough 1975	7	76	8	76	15.1%	0.86 (0.30, 2.51)
Harimoto 2011	7	62	10	63	15.6%	0.67 (0.24, 1.90)
Kotaluoto 2012	3	90	7	95	10.9%	0.43 (0.11, 1.73)
Lundblad 1989	8	78	4	78	12.6%	2.11 (0.61, 7.33)
Pauniaho 2010	1	79	2	87	4.5%	0.54 (0.05, 6.13)
Ralphs 1982	1	56	3	66	5.0%	0.38 (0.04, 3.78)
Szabo 2002	1	25	1	25	3.4%	1.00 (0.06, 16.93)
Tan 2008	5	106	9	107	14.2%	0.54 (0.17, 1.67)
Total (95%CI)		663		691	100.0%	0.97 (0.56, 1.69)
Total events	54		53			

Heterogeneity: Tau^2 = 0.23, χ^2 = 12.12, *df* = 8 (*P* = 0.15); I^2 = 34%
Test for overall effect: *Z* = 0.11 (*P* = 0.92)

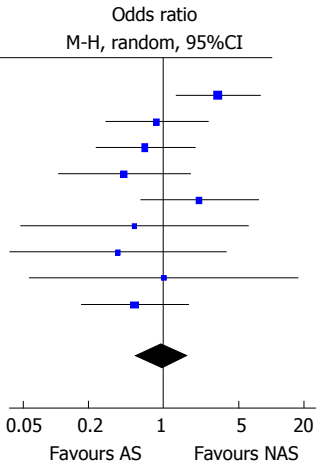

Figure 3 Forest plot for surgical site infection following the use of absorbable suture and non-absorbable suture for skin closure. Odds ratios are shown with 95%CI. AS: Absorbable stitch; NAS: Non-absorbable stitch.

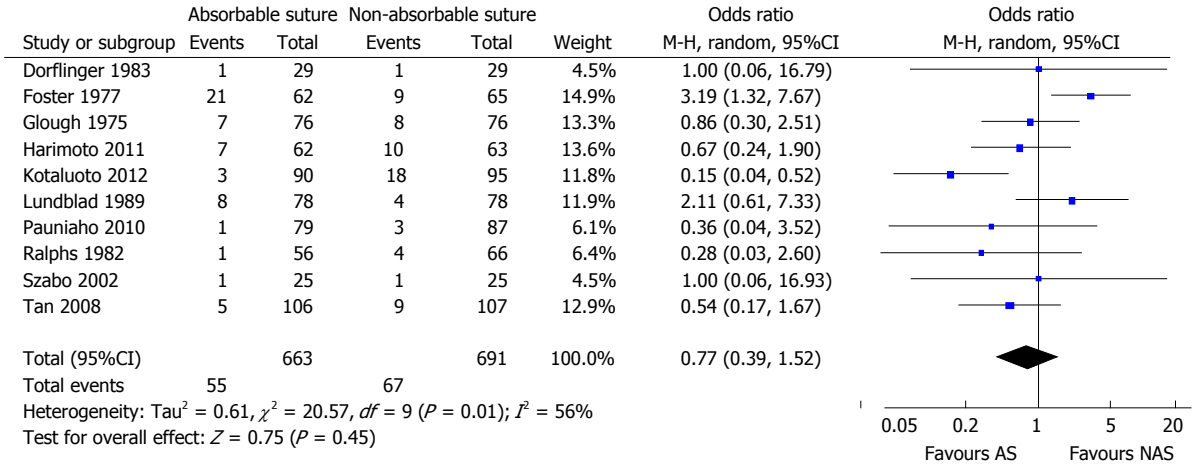

Figure 4 Forest plot for postoperative complications following the use of absorbable suture and non-absorbable suture for skin closure. Odds ratios are shown with 95%CI. AS: Absorbable stitch; NAS: Non-absorbable stitch.

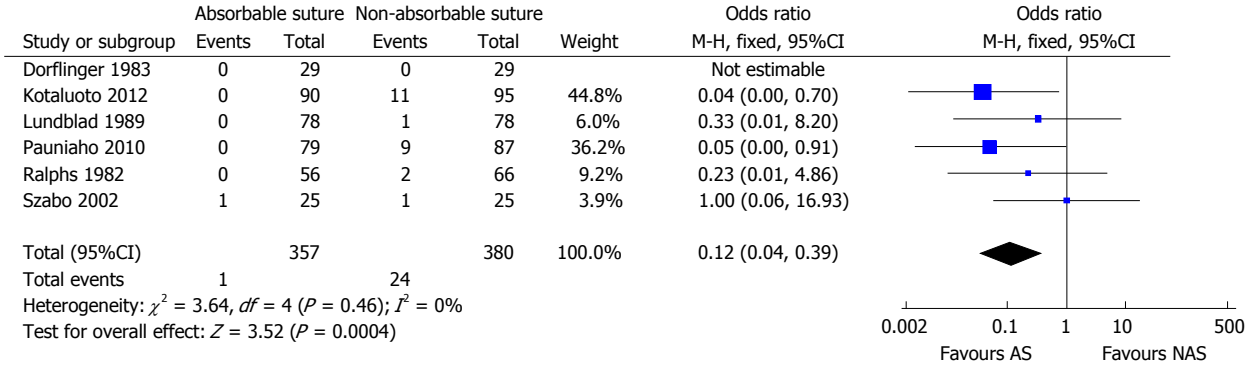

Figure 5 Forest plot for the risk of wound dehiscence following the use of absorbable suture and non-absorbable suture for skin closure. Odds ratios are shown with 95%CI. AS: Absorbable stitch; NAS: Non-absorbable stitch.

$Z = 0.75$; $P = 0.45$; Figure 4), the incidence of operative morbidity was statistically comparable in both arms of included RCTs. Although the AS was associated with the reduced risk of developing postoperative complications but statistically it was not significant.

Risk of wound dehiscence

There was no heterogeneity [$\chi^2 = 3.64$, $\gamma = 4$, ($P = 0.46$); $I^2 = 0\%$] among included RCTs. Six trials[32,36-40] contributed to the combined calculation of this variable. Therefore, in the random effects model (OR = 0.12; 95%CI: 0.04, 0.39; $Z = 3.52$; $P < 0.0004$; Figure 5), the use of AS was associated with the reduced risk of developing wound break-down.

Other variables

Authors initially planned to analyse other outcome measures such as cosmetic outcomes, stitch granulomas, health-related quality of life measurement, and outcomes comparisons between contaminated and non-contaminated skin wound closures but unfortunately there was either insufficient data reporting or these variables were not investigated.

DISCUSSION

The findings of this review article demonstrate that the use of AS is similar to NAS for skin closure for surgical site infection and other operative morbidities. AS do not increase the risk of skin wound dehiscence, rather lead to a reduced risk of wound dehiscence compared to NAS.

The conclusions of this study are consistent with the previously reported several RCTs[32,34-41] and comparative studies[32,34,35,37-41]. Majority of these studies compared the usage of AS against NAS by continuous skin closure stitches. Two trials[33,36] compared the use of AS with NAS by interrupted skin closure stiches. Their outcome was also in favour of AS as for as surgical site infection and postoperative complications are concerned. The comparison between continuous stitch *vs* interrupted stitch closure of skin by using absorbable or non-absorbable sutures could not be performed in this review due to scarcity of trials and number of patients. Therefore, it is difficult to analyse and conclude the superiority of any technique of skin closure.

Current study has many limitations. There were substantial variances in the inclusion criteria such as RCTs

on general surgical patients, plastic surgical patients and gynaecology were jointly analysed in this review which may be a potential source of bias due to diversity of patients. Further sub-classification of patients in the form of clean and contaminated wounds was not reported and therefore subgroup analysis was not possible to detect the difference in complications and wound infection following the use of AS and NAS. Varying degrees of differences also existed among included RCTs in terms of the definitions of "wound infection" and "wound dehiscence". RCTs with fewer patients may not have been sufficient power to recognise small differences in primary and secondary outcomes. Different skin closure techniques like interrupted, subcuticular and continuous suturing were reported in included trials. In addition, different types of absorbable sutures were used in the included studies and one may consider this biased. Inadequate randomization approach, improper concealment in the process of allocation, absence of power calculations, lack of utilization of single or double blinding and lastly lack of reporting of IIT were major factors responsible for scoring the majority of included RTCs of poor quality. Variables like foreign body sensation, stitch granulomas, cosmetic score, health-related quality of life measurement and cost effectiveness should have been considered too. Due to significant clinical and methodological diversity among included studies in addition to aforementioned several limitations, a major, multicentre and high quality randomized, controlled trial is required to validate these findings before recommending the routine use of AS for skin closure.

COMMENTS

Background

The conventional way of closing surgical incision wound by non-absorbable interrupted stitches have been largely replaced by the use of absorbable stitches without any conclusive and undisputable evidence in the medical literature. The aim of this article is to find relevant randomized, controlled trials and attempt to generate a guiding evidence to achieve this goal.

Research frontiers

Several study cohorts, comparative studies and randomized trials have been reported comparing absorbable stiches and non-absorbable stitches to close surgical incision wounds with outcomes reported in favour as well as against the use of either suture. Other major concern reported in the published studies was the prevalence of surgical site infection and wound dehiscence. Due to lack of consensus statement on this issue, the evidence based practice is lacking and this article is an attempt to clarify this confusion.

Innovations and breakthroughs

Based upon the meta-analysis of 10 controlled trials, the absorbable sutures are similar to non-absorbable sutures for skin closure in cases of wound infection and other complications. Absorbable sutures do not increase the risk of skin wound dehiscence, rather leads to a reduced risk of wound break-down compared to non-absorbable sutures.

Applications

To the authors' knowledge this is first systematic review reporting the comparison of both wound closure techniques and highlighting the value of the routine of absorbable stitches for the closure of surgical incision wound.

Terminology

AS: Absorbable stitch; NAS: Non-absorbable stitch; OR: Odds ration; SMD: Standardized mean difference.

Peer review

This is an important paper focusing on systematically analysis of the randomized, controlled trials comparing the use of absorbable *vs* non-absorbable suture for skin wound closure in surgical patients.

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